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VEGETATION OF AN INFREQUENTLY BURNED TASMANIAN MOUNTAIN REGION

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Abstract: The Mt. Bobs-Boomerang area in southern Tasmania is rugged and mountainous (600-1080 m above sea level), with a perhumid cool (Thornthwaite classification) climate and a range of geological substrates including mudstone, sandstone, limestone and dolerite. 164 species of vascular plants, all native to Tasmania, have been recorded in the study area. The subalpine vegetation is composed primarily of rainforest and scrub communities. Fires have had major effects on these communities, but are rare; the period since the last fire varies between about 50 and 500 years. A small area of herbland and heathland occupies the poorly drained valley floors and different herbland communities are found on the flats and limestone cliffs around Lake Sydney.

Above the treeline, which occurs at about 1000 m on Mt. Bobs and the Boomerang, heathland is the major vegetation formation. Herblands are found in sheltered sites with the longest snowlie, and fjaeldmark, much of it associated with a pattern of non-sorted solifluction terraces, occupies the highest, most exposed part of the mudstone-capped Boomerang.

Exposure to strong winds, snowlie, substrate type, degree of waterlogging and fire frequency appear to be major environmental determinants of the plant communities.

INTRODUCTION

Fifty-five per cent of the high mountain country of Australia lies within Tasmania (Costin 1973). The Tasmanian high mountain vegetation differs markedly from that of the mainland. It is more Antarctic (Stones & Curtis 1967) than Australian in its floristic affinities and largely dominated by shrubs rather than grasses and forbs. Jackson (1973) has described the varied vegetation of the Central plateau, and Sutton (1928) has described part of the vegetation of the plateau and peaks of the Cradle Mountain-Lake St. Clair National Park. These two regions form the largest contiguous area of high mountain vegetation in Australia. The vegetation of the outlying high dolerite plateaux of the northeast of Tasmania is undescribed, and among the numerous 'islands' in the high mountain archipelago to the south and west of the Central Plateau (Fig. 1) only the vegetation of Mt. Field (Davies 1978), the West Coast Range (Kirkpatrick 1977) and Mt. Wellington (Martin 1940, Ratkowsky & Ratkowsky 1976, 1978), are reasonably well-documented. One of the major gaps in the literature of Tasmanian high mountain vegetation is the complete lack of any published work relating to the South-West, where the mountains are concentrated in the eastern part of the largest wilderness area in temperate Australia.

Mountains such as the Eastern and Western Arthur Ranges, Precipitous Bluff, Mt. Anne and Mt. Bobs are becoming increasingly used for wilderness recreation, and at the same time the distance between them and areas of intensive land use and easy access is shrinking. Much of their vegetation is ill-adapted to fire and trampling yet is of intense scientific interest, since it is largely dominated by endemic and/or Antarctic elements of the Tasmanian flora. These elements have been seriously reduced in area and richness on many of the mountains of Tasmania by the firing and logging that has taken place since white settlement (Jackson 1973, Kirkpatrick 1977a, 1977b).

Of the mountains of the South-West only the Mt. Anne massif and the Mt. Bobs-Boomerang complex still retain large diverse areas of Antarctic vegetation. All other ranges of the South-West have been burnt over in the last two centuries, although none lack remnants of their original vegetation. The Mt. Anne and Mt. Bobs areas have avoided fire because of their remoteness from humans, the presence of topographic barriers and because they are surrounded on most sides by large areas of relatively non-inflammable (Jackson 1968) temperate rainforest. Their isolation has decreased in the last decade, with a large hydro-electric scheme and roading near Mt. Anne, and the extension of logging into the Picton Valley near Mt. Bobs. Logging is likely to advance closer to both mountains, and would bring with it an increased fire risk.

This article provides a preliminary account of

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the vegetation patterns and processes in the Mt. Bobs-Boomerang complex (Fig. 2).

THE AREA

The Mt. Bobs plateau reaches a height of 1000-1080 m above sea level (Fig. 2). It consists of a sill of Jurassic dolerite whose margins form steep slopes in all directions. The Boomerang has a smaller area above 1000 m. It is immediately adjacent to Mt. Bobs, separated from it by a steep saddle. It is geologically quite distinct from Mt. Bobs, having been carved in Permian sediments that are bedded almost horizontally, with a dip of about 5° to the cast. A thin capping of mudstone overlies sandstone on the 'bend' of the Boomerang, but wedges out about one-third of the way along each 'arm', beyond which points the more resis-

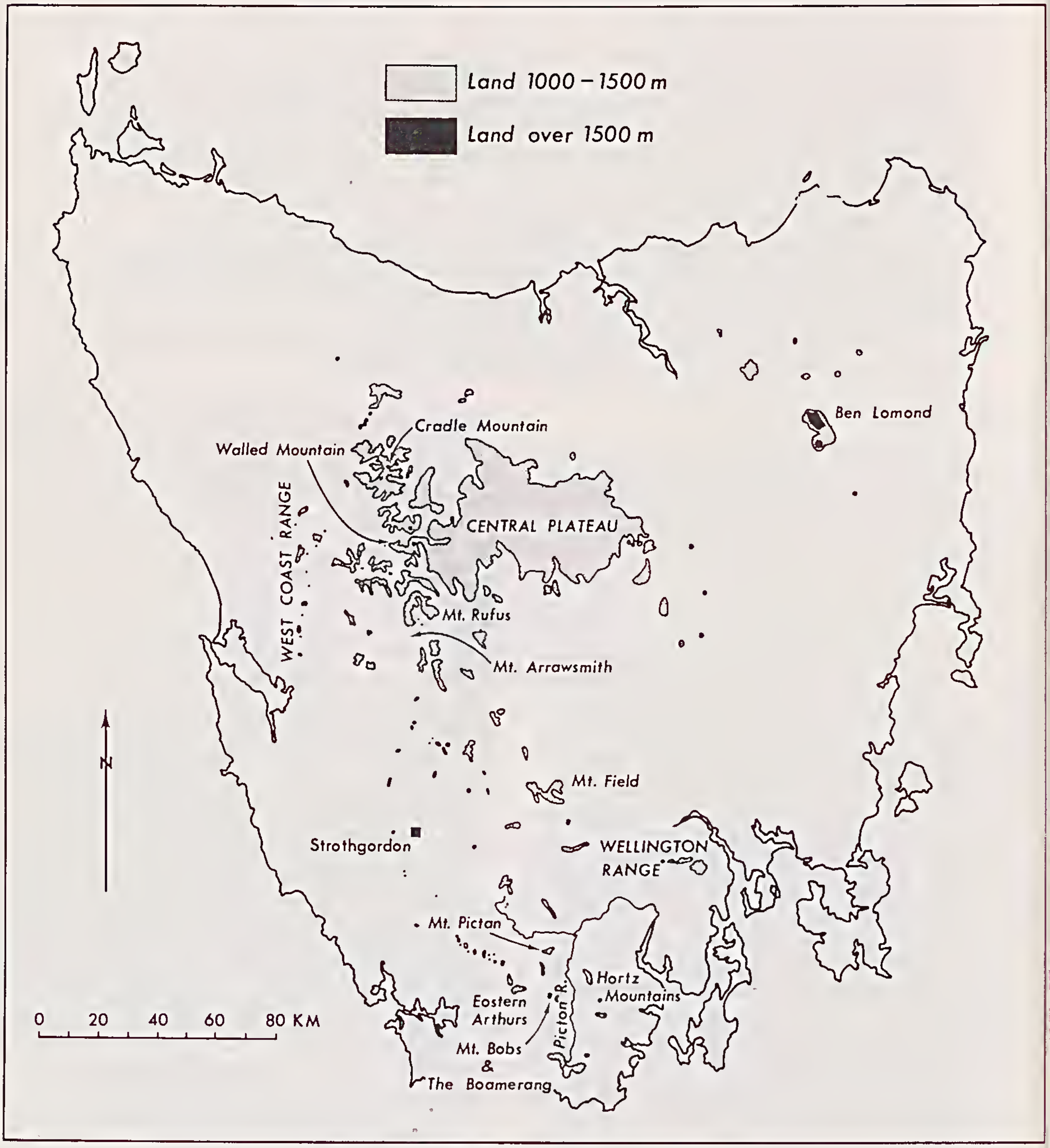

Fig. 1 — High mountain areas of Tasmania.

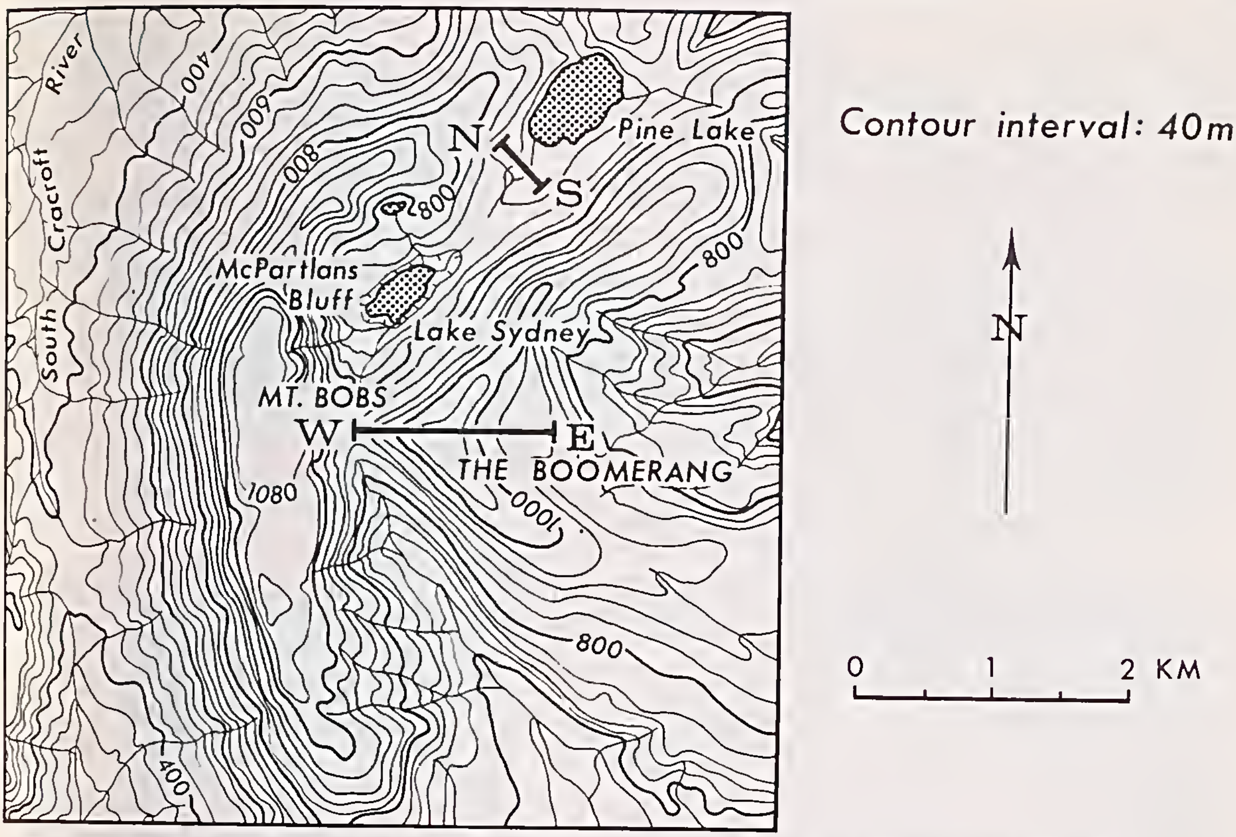

Fig. 2 — Topographic map of the Mt. Bobs-Boomerang area showing the location of the transects (Figs. 6 and 7).

tant sandstone is exposed. Differential erosion of the sedimentary strata has produced a series of plateaux and cliffs surrounding the ridge of the Boomerang and extending down to 600 m above sea level. The valley extending to the northeast of Mt. Bobs and bounded to the southeast by the northern 'arm' of the Boomerang has been glaciated, and till overlies the bedrock along most of its length. It is only around Lake Sydney that Gordon limestone is exposed in a few cliffs, valleys, and a sinkhole which drains Lake Sydney and its catchment. When full, this sinkhole is contiguous with Lake Sydney and has a depth of over 15 m. When the water level drops by more than 2 m, Lake Sydney and the sinkhole become separated, the outflow from the lake draining by a creek into the sinkhole. The sinkhole can fill in a single day following heavy rain, and empty just as rapidly. This unusual drainage system results in fluctuations in the level of the sinkhole and the upper 2 m of Lake Sydney of a greater order of magnitude and much shorter periodicity than those that occur in most lakes in the humid west of Tasmania. Pine Lake, the other major water body in the valley, drains to the northeast in the normal manner.

No climatic data are available from sites in or near the study area. The precipitation patterns experienced at Hartz Mountains and Strathgordon (Fig. 1) are shown in Table 1. Precipitation in the study area is probably intermediate between that of these two sites. More than three consecutive days without precipitation is exceptional, judging from the accounts of parties that have visited the area. In common with other Tasmanian mountains, Mt. Bobs and the Boomerang can

Table 1
Precipitation Data for Strathgordon (8 years) and Hartz Mountains (12 years)

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Strathgordon													
Mean (mm)	137	96	137	234	272	257	294	267	292	207	194	243	2630
Raindays	17	11	16	21	22	23	25	23	22	21	19	24	244
Hartz Mountains													
Mean (mm)	91	95	116	184	205	152	146	139	182	142	142	113	1707

receive a covering of snow at any time of the year, and the exposed plateaux and mountain tops are subject to strong and persistent westerly winds. Snow lies in drifts on lee slopes and in hollows near the mountain summits for about 4-5 months in average years, but the period of continuous cover is considerably shorter for most of the area.

The Mt. Bobs-Boomerang alpine complex forms an island of open vegetation among a sea of temperate rainforest and rainforest scrub (Fig. 3). The only species of eucalypt found in the study area is *Eucalyptus vernicosa*, a shrub sized subalpine species able to regenerate in the open conditions at high altitude without the intervention of fire.

METHODS

The vegetation of the area shown in Fig. 4 was mapped from interpretation of vertical aerial photographs and ground survey undertaken in December 1977. The fire boundaries shown in Fig. 4 were evident on both the photographs and on the ground from the skeletons of *Athrotaxis selaginoides* and height differences in the vegetation.

Species lists of all gymnosperms, angiosperms and pteridophytes were made at the locations shown in Fig. 5. At each of these sites notes were made of the structure of the vegetation and the species exhibiting the greatest cover in the tallest stratum. Species not found at these locations but occurring within the study area were also listed and/or collected. The species observed in the area mapped in Figs. 4 and 5 are listed in the Appendix. Taxonomic nomenclature follows Curtis (1963, 1967) and Curtis and Morris (1975) for gymnosperms and dicotyledons and Willis (1970) for

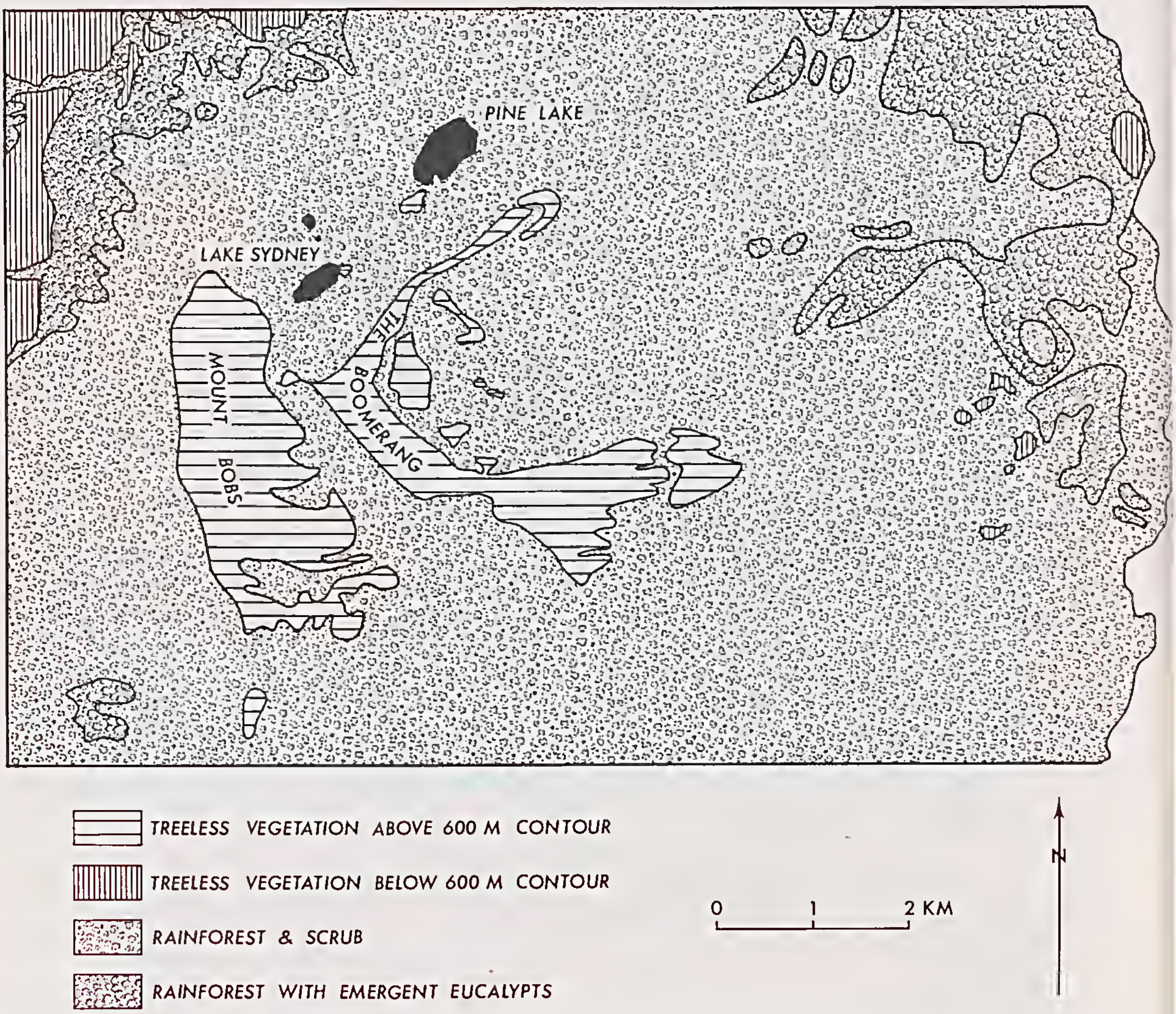

Fig. 3 — Vegetation map of the area surrounding the mountains.

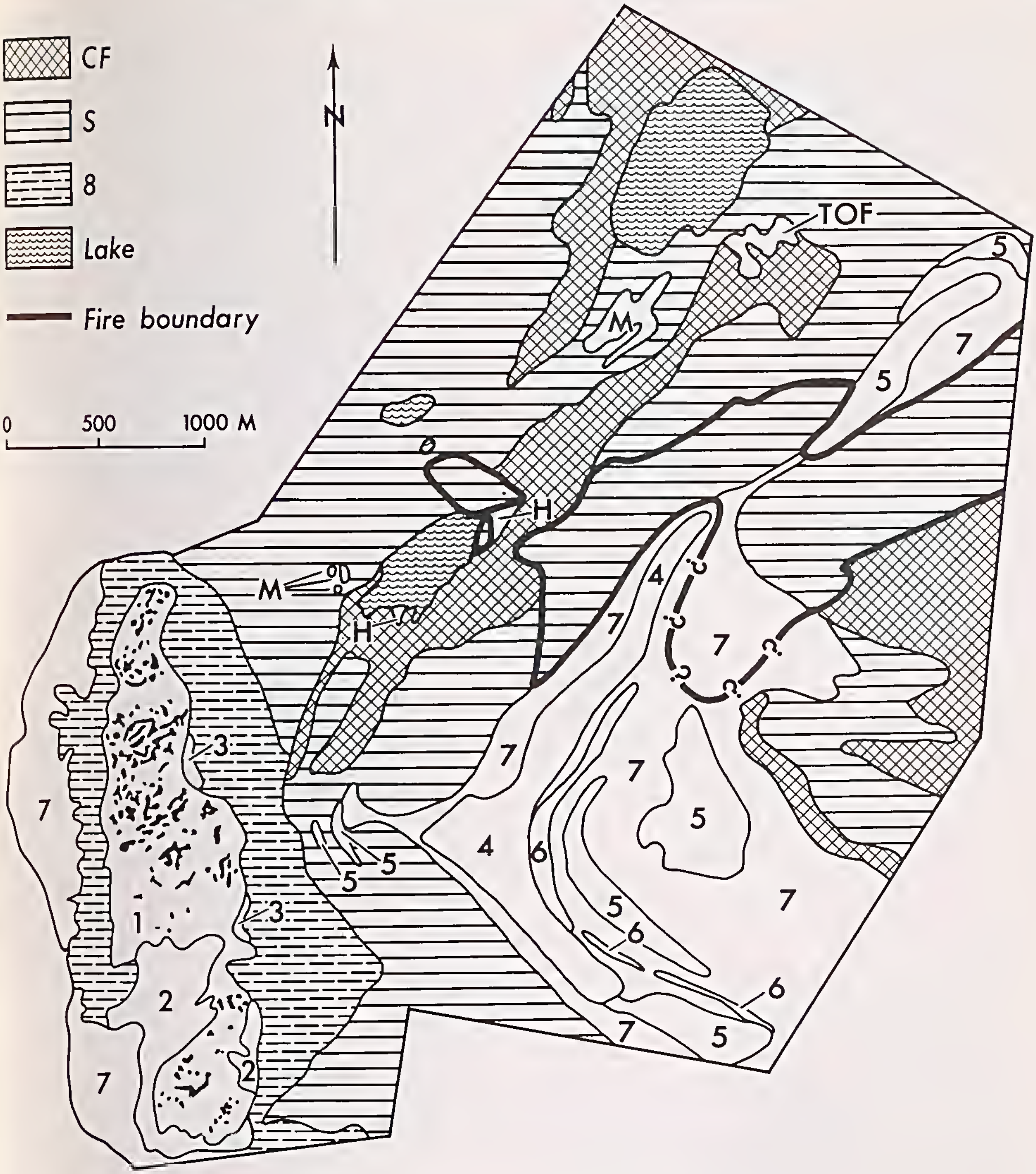

Fig. 4 — Vegetation mapping units, and fire boundaries.
TOF = *Athrotaxis selaginoides* tall open-forest; CF = *A. selaginoides-Nothofagus cunninghamii* closed-forest; S = low closed-forest and closed-scrub; H = closed-herbland; M = moor (see Fig. 6 for structural types); 1 = Low-heath and low shrubland. The white areas are low closed-heath and low-shrubland. The black areas are low open-shrubland in waterlogged depressions; 2 = *Diselma archeri-Bellendena montana* heath; 3 & 6 = *Milligania densiflora-Astelia alpina* herbland; 4 = Fjaeldmark and low closed-heath on mudstone; 5 = *Donatia novae-zelandiae-Oreobolus pumilio* low closed-heath on sandstone; 7 = *Richea scoparia-Nothofagus cunninghamii* closed-heath; 8 = *Diselma archeri-Bellendena montana* heath and over 50% bare rocks.

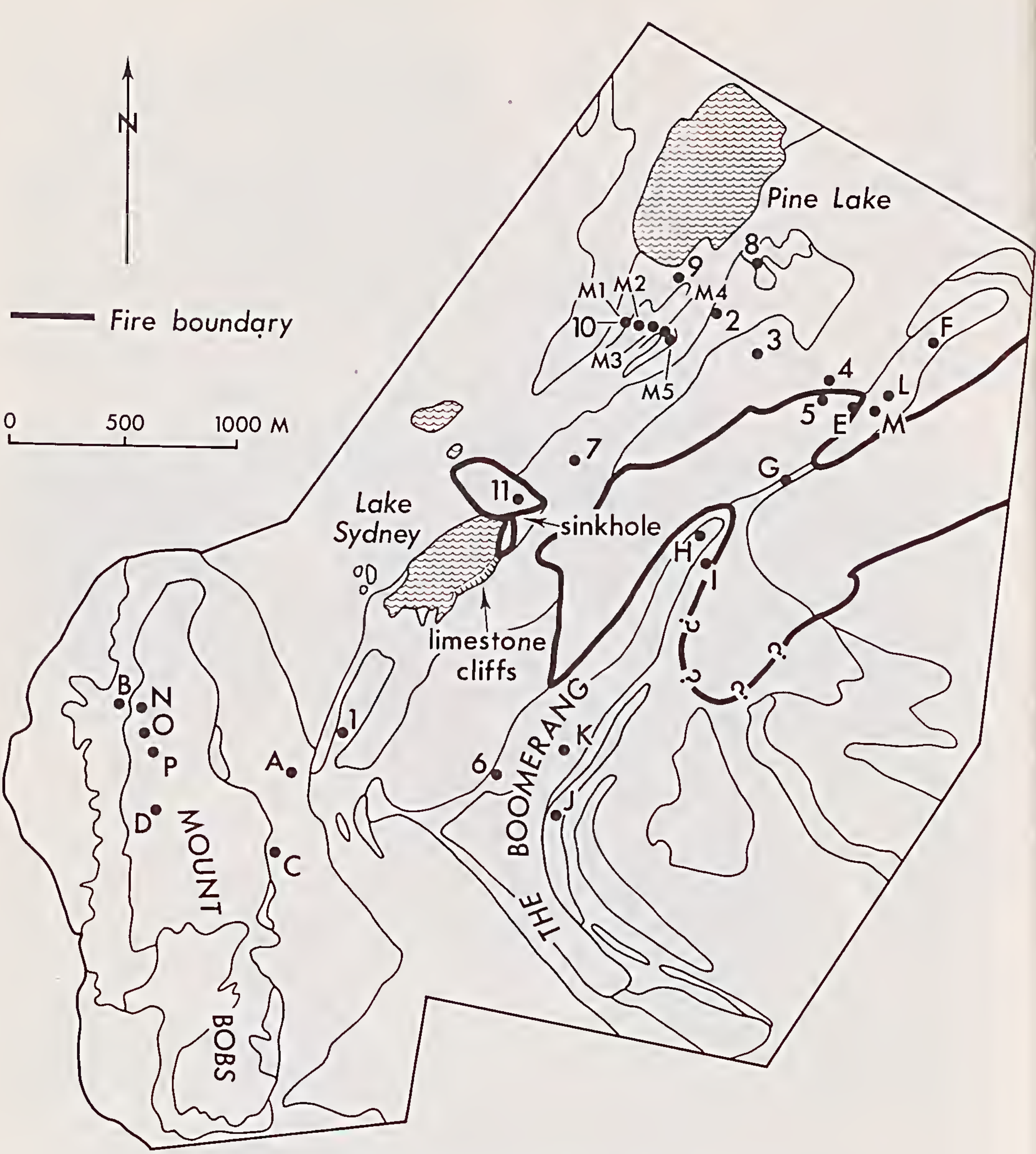

Fig. 5 — Locations referred to in Tables 2 and 5, and in the text.

monocotyledons and pteridophytes, except where other authorities are given in the Appendix. Structural nomenclature follows Specht (1970) except that the term 'fjaeldmark' is used in the sense of Barrow *et al.* (1968) and heath and closed-heath are used to describe vegetation 0.2-2 m tall with the prefix 'low' denoting heath less than 0.2 m tall.

The site species lists were formed into site-species matrices for the forest-scrub and treeless areas. These matrices were successively re-sorted to form species-site blocks. The point-centred quarter method (Mueller-Dombois & Ellenberg 1974) was used to obtain density and basal area figures for the *Athrotaxis selaginoides* tall open-forest near Pine Lake. The tree diameter at breast height and distance from the point were measured for trees greater than 10 m tall, and the height of each tree estimated. For shrubs and trees between 0.5 and 10 m tall distance from the point was measured and height estimated. These measurements and estimations were made on four trees and shrubs at each of twelve points located non-purposively within relatively uniform forest. Increment cores were taken from several trees in this and other areas to obtain information on age and growth rate.

VEGETATION DOMINATED BY TREES AND TALL SHRUBS

Trees and tall shrubs generally extend upwards to an altitude of 1000 m. Their absence above this altitude appears to be attributable to the effects of exposure, rather than to low temperature, as a few flag-form, shrub-sized *Athrotaxis selaginoides* are found at about 1000 m on the more sheltered slopes of both mountains. The most wind-exposed and/or poorly drained areas below 1000 m are treeless.

The vegetation map discriminates between tall open-forest, closed-forest and scrub (Fig. 4). The latter two of these mapping units contain a diversity of vegetation that was not practical to map. Table 2 shows some of the range of floristic variation in the forest and scrub of the area. The most frequent species (Group A, Table 2) are those typical of high altitude forest and scrub communities where fire is a rarity (Sutton 1928, Kirkpatrick 1977). The species in Group B and C are those of the closed-scrub and closed-forest of steep sites with shallow soils. These communities are much richer in species than the forests of better sites. Group F consists of species that typically occur in the high altitude heaths and herblands, but which are found in the lower strata of the high altitude scrub communities that have not completely recovered from fire. Groups E and G are typical of open communities found in areas with impeded drainage.

Four species dominate almost all the forest and scrub in the study area: *Athrotaxis selaginoides, Nothofagus cunninghamii, N. gunnii* and *Leptospermum nitidum*, the latter being a sparse emergent over communities dominated by *Nothofagus* species (e.g. Fig. 6). The major communities, defined on a basis of structure, dominance and species composition are:

a) *Athrotaxis selaginoides* Tall Open-Forest

This community is restricted to an area of about 5 ha south of Pine Lake (Fig. 4) where it occurs on moderate slopes on sandstone till. The uppermost stratum has a cover of about 50% and is occupied entirely by *A. selaginoides*, which reaches heights of 25-35 m. The trees lean in a variety of directions at angles of up to 15° from the vertical, but most are straight and single-boled with a narrow crown accounting for about one fifth of the height.

The second stratum in the forest consists of *Nothofagus cunninghamii* and *Atherosperma moschatum* which are 15-25 m tall and collectively have a cover of approximately 10%. Many trees in this intermediate height class are dead or appear to be dying back. *Richea pandanifolia* 5-15 m tall forms a sparse third stratum with approximately five per cent cover. The fourth stratum, which has a cover of approximately twenty-five per cent, consists largely of spreading, 2-3 m tall shrubs of *Archeria eriocarpa*. There is abundant regeneration of *Nothofagus cunninghamii, Atherosperma moschatum* and *Phyllocladus aspleniifolius*, mainly concentrated on logs.

The floristic composition of the stand (8) is shown in Table 3 where the dominance of *A. selaginoides* is testified by the measurements shown. The trees of this species are not only taller than those of *N. cunninghamii* and *A. moschatum*, they are also concentrated in larger basal area classes. Although the basal areas of individuals of *A. selaginoides* vary markedly there appears to be less variation in age. Ring counts on increment cores taken at breast height from 8 trees with d.b.h.'s ranging from 43 to 175 cm were made and minimum ages of 350 to 447 years obtained. In all cases the actual age would be considerably higher, as the species takes several decades to reach breast height, averaging 42 years old at 1 m for stands near Mt. Field (Ogden 1978). Two trees may have been considerably older as the centre was not reached with the increment core.

b) *Athrotaxis selaginoides-Nothofagus cunninghamii* Closed-Forest

This community constitutes most of the area of closed-forest mapped in Fig. 4. It occurs on soils formed on limestone, glacial till and sandstone. *A. selaginoides* usually accounts for 10-30% of the cover in the dense canopy, *N. cunninghamii* providing the rest. There is generally a sparse second layer consisting

TABLE 2

SUBALPINE FOREST AND SCRUB COMMUNITIES

		Site (see Figure 5)											
		7	8	6	5	1*	2	3	4	9	12	11*	10
		CF	TOF	CS	CS	CS	LCF	CS	LCF	CS	OS	OS	OS
A	*Eucryphia milliganii*	x	x	x	x	x	x	x	x	x	x	x	x
A	*Nothofagus cunninghamii*	x	x	x	x	x	x	x	x	x	x	x	-
A	*Phyllocladus aspleniifolius*	-	x	-	x	x	x	x	x	x	x	x	x
A	*Orites diversifolia*	-	-	x	x	x	x	x	x	x	x	x	x
A	*Richea scoparia*	-	-	x	x	x	-	x	x	x	x	x	x
A	*Astelia alpina*	-	x	x	x	-	x	x	x	x	x	x	x
A	*Prionotes cerinthoides*	x	x	-	x	-	x	-	x	x	x	x	x
A	*Athrotaxis selaginoides*	x	x	x	x	-	-	x	x	x	x	x	-
A	*Richea pandanifolia*	x	x	x	-	x	x	-	x	-	x	x	x
B	*Cennarhenes nitida*	-	-	-	x	x	x	x	x	x	x	-	x
B	*Richea milliganii*	-	-	-	x	x	x	x	x	x	x	-	x
B	*Cyathodes juniperina*	-	-	-	x	x	-	x	x	x	x	x	-
B	*Olearia persoonioides*	-	x	-	x	-	x	x	x	x	x	-	-
B	*Agastachys odorata*	-	-	-	x	x	x	x	-	x	x	-	-
B	*Anodopetalum biglandulosum*	-	-	-	-	x	x	x	-	-	x	-	-
C	*Archeria hirtella*	-	-	-	-	-	x	x	x	-	x	-	x
C	*Blechnum wattsii*	-	-	-	-	-	x	x	x	-	-	-	-
C	*Archeria eriocarpa*	x	x	x	-	-	x	x	x	-	-	-	-
D	*Trochocarpa cunninghamii*	x	-	x	-	-	-	x	x	-	x	x	-
D	*Drimys lanceolata*	-	x	x	x	-	x	-	x	-	x	x	-
E	*Leptospermum nitidum*	-	-	-	-	x	x	-	-	-	x	x	x
E	*Lomatia polymorpha*	-	-	-	-	x	-	x	-	-	x	x	x
F	*Monotoca submutica*	-	-	-	x	x	-	-	x	x	x	-	-
F	*Bauera rubioides*	-	-	-	x	x	-	-	-	-	x	-	x
F	*Diplarrena latifolia*	-	-	-	x	x	-	-	-	-	x	-	-
F	*Persoonia gunnii*	-	-	-	x	x	-	-	-	x	-	-	-
F	*Oreobolus acutifolius*	-	-	-	x	x	-	-	-	-	-	-	-
F	*Epacris serpyllifolia*	-	-	-	x	x	-	-	-	-	-	-	-
F	*Calorophus elongatus*	-	-	-	x	x	-	-	-	-	-	-	-
G	*Nothofagus gunnii*	-	-	-	-	-	-	-	-	x	x	-	x
G	*Tetracarpaea tasmanica*	-	-	-	-	-	-	-	-	x	x	x	-
	Gahnia grandis	-	-	-	x	-	-	-	-	x	-	-	x
	Microlaena tasmanica	-	-	-	x	-	-	-	x	-	-	x	x
	Coprosma nitida	-	-	-	-	-	-	x	x	-	-	x	-
	Telopea truncata	-	-	-	-	x	-	x	-	-	x	-	-
	Diplaspis cordifolia	-	-	-	-	-	-	-	-	-	-	x	-
	Number of species	7	13	12	27	23	18	20	21	17	28	20	16

Additional species: *Acaena novae-zelandiae* (11), *Anopterus glandulosus* (2), *Atherosperma moschatum* (8), *Bellendena montana* (11), *Blandfordia punicea* (5), *Exocarpos humifusus* (5), *Gleichenia dicarpa* (5), *Grammitis billardieri* (8), *Lycopodium fastigiatum* (12), *Olearia pinifolia* (6), *Oxalis lactea* (11), *Sprengelia incarnata* (1), *Stylidium graminifolium* (1).

(* = Burnt within last 100 years, TOF = tall open forest, CF = closed forest, LCF = low closed forest, CS = closed scrub, OS = open scrub)

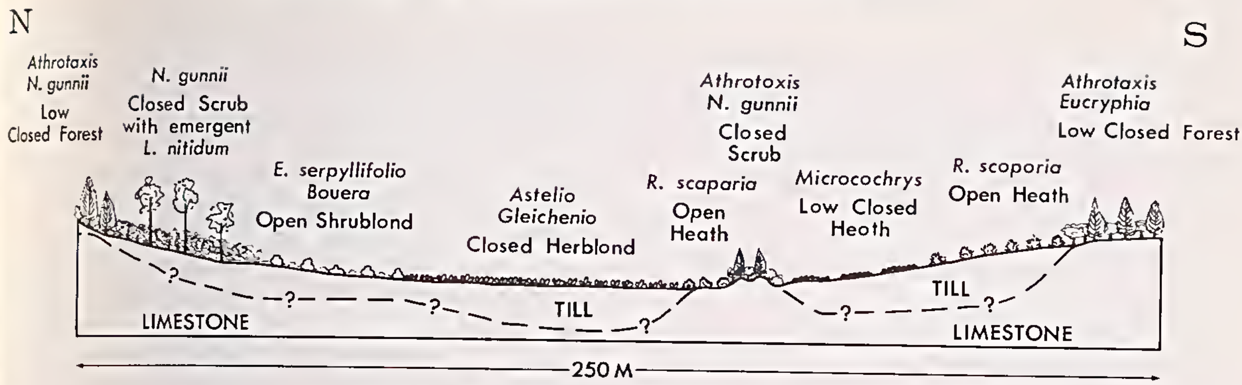

Fig. 6 — Transect across Pine Lake moor.

of *Eucryphia milliganii* and *Richea pandanifolia* 3-8 m tall, and a sparse third layer dominated by 1-3 m tall *Archeria eriocarpa*. Mosses, lichens and filmy ferns cover almost every surface in the humid sub-canopy micro-environment. The number of species of vascular plants is generally less than 10 (e.g. 7, Table 2), and the forest floor is extremely open.

c) *Nothofagus cunninghamii* Closed-Forest

This community is restricted to some of the deeper valleys to the southwest of Lake Sydney. It is similar in its characteristics to the preceding community except that *A. selaginoides* is absent, *Atherosperma moschatum* is much more common and the second layer described above is often absent.

d) *Athrotaxis selaginoides-Nothofagus cunninghamii* Low Closed-Forest to Closed-Scrub

This community is widespread in the area mapped as closed-scrub, but is concentrated on well-drained, rocky upper slopes and is absent from within the burnt areas marked in Fig. 4. The community is generally richer in species (e.g. 3, 4, 5 and 6, Table 2) than those previously described, and the upper stratum is shared by species such as *Phyllocladus aspleniifolius*, *Richea pandanifolia*, *Orites diversifolia*, *Cenarrhenes nitida*, *Agastachys odorata*, *Richea milliganii* and *R. scoparia*. The size of normally shrubby species such as *Richea scoparia* is quite remarkable in parts of this community. For instance, near Lake Sydney individuals of this species have a basal diameter of almost 20 cm and are over 6 m tall.

There is typically no distinct understorey-layer, the stratum below the crowns of the dominants being occupied by a tangled mass of moss-covered stems. The ground is also moss-covered with a sprinkling of herbaceous species such as *Astelia alpina* and ferns such as *Blechnum wattsii*.

e) *Nothofagus cunninghamii* Closed to Open-Scrub

This community is restricted to areas where *A. selaginoides* has been unable to re-establish since the last fire, and is most extensive within the fire boundaries shown in Fig. 4. Site 1 (Table 2) is representative of the more open areas of this community. The ability of *N. cunninghamii* individuals to coppice allows them to survive fires which would kill *Nothofagus gunnii*, *Athrotaxis selaginoides* and *Phyllocladus aspleniifolius*. *Eucryphia milliganii* and *Orites diversifolia* often share dominance with *N. cunninghamii*.

f) *Athrotaxis selaginoides-Nothofagus gunnii* Open-Scrub

This community occurs on south-facing slopes where the soil is more or less constantly moist as a result of seepage through terminal moraines on gentle slopes. It is absent from the northern slopes of the Boomerang. Sites 9 and 12 (Table 2) are typical of the community which is the richest of all the forest and scrub communities in tree and scrub species. *Nothofagus gunnii*, the only Australian winter-deciduous tree species, forms most of the cover in the tallest stratum. The other species most common in this stratum are *A. selaginoides*, *Phyllocladus aspleniifolius* and *N. cunninghamii* but they collectively constitute less of the cover than *N. gunnii*. The understorey consists of a tangled mass of stems of the dominants interspersed with pungent-leaved shrubs of varying sizes and shapes. As with all the forest and scrub communities the ground and lower stems are densely covered by mosses and lichens. *A. selaginoides* is absent from the community where drainage is poor. In these locations occasional emergent individuals of *Leptospermum nitidum* are found.

VEGETATION DOMINATED BY SHRUBS AND/OR HERBS

(a) The Lake Sydney Herbfields

The sinkhole and the upper zone of fluctuating waterlevel around Lake Sydney carry a distinctive herbaceous vegetation. At the sinkhole *Hydrocotyle muscosa* and moss are found over the full range of water-

TABLE 3

CHARACTERISTICS OF THE *Athrotaxis selaginoides* TALL OPEN-FOREST NEAR PINE LAKE

Species	Mean Height (m)	% relative abundance	Density per 100 m²	Basal area (m^2/ha)	% frequency by basal area class (cm^2) 0-1000	1001-2000	2001-3000	3001-4000	4001 +
Trees > 10 m									
Athrotaxis selaginoides	28	52	5.1	150	12	36	24	4	24
Nothofagus cunninghamii	21	36	3.4	64	18	41	29	12	-
Atherosperma moschatum	16	12	1.2	5	100	-	-	-	-
Shrubs and trees 0.5–10 m									
Richea pandanifolia	3.2	15	8.5						
Archeria eriocarpa	1.9	65	37.8						
Nothofagus cunninghamii	1.0	8	4.8						
Eucryphia milliganii	1.7	4	2.4						
Atherosperma moschatum	5.0	4	2.4						
Phyllocladus aspleniifolius	1.5	2	1.2						
Olearia persoonioides	2.0	2	1.2						

levels. Near the highest levels *Juncus subsecundus*, *Ranunculus collins* and *Bellendena montana* are conspicuous. Near the base of the sinkhole depression *Blechnum penna-marina* and *Haloragis montana* occur as occasional individuals on small cliffs.

Along the shores of Lake Sydney zones dominated by *Juncus subsecundus*, *Bellendena montana* and *Hydrocotyle muscosa* can be distinguished. Where the shore forms a gentle slope small trees of *Leptospermum nitidum* are found at the rear of the *H. muscosa* herbland.

Around much of the lake shore the limestone bedrock is overlain by dolerite rubble derived from the Mt. Bobs range. However, there are limestone cliffs along the southern shore which carry a floristically distinct vegetation on ledges and in crevices. This vegetation consists largely of ferns, grasses and forbs. Twenty-four of the thirty-three species recorded for the limestone cliffs and shores of Lake Sydney and the sinkhole were not recorded elsewhere in the study area (Appendix), and soft herbaceous species are virtually confined to the limestone.

(b) THE PINE LAKE MOOR

The moor near Pine Lake (Fig. 4) differs markedly in character from the treeless areas around Lake Sydney. Its treeless nature appears to be maintained by the impedence of drainage caused by the deposition of till in the flattest part of the valley. The moor, although only about 5 ha in area, contains a wide diversity of communities (Table 4, Fig. 6). *Astelia alpina-Gleichenia alpina* closed-herbland occurs in the lowest-lying part of the moor. Parts of this community were covered by water in early summer (November and December 1977). In situations with slightly better drainage there is an *Epacris serpyllifolia-Bauera rubioides* open shrubland with a herbaceous understorey dominated by *Astelia alpina* and *Gleichenia alpina*. With further improvement in drainage, *Microcachrys tetragona* dominates a low closed-heath on gentle (up to 5°) slopes in the southern part of the moor. Here the ground is gently undulating, and *M. tetragona* spreads over the low (10-20 cm) hummocks, the depressions being occupied by *Astelia alpina*, *Calorophus minor*, *Sprengelia incarnata* and *Carpha alpina*. Further upslope, *Richea scoparia* forms an open heathland in which *Microcachrys* is almost completely absent, although the understorey is in other respects very similar. The structural boundaries between these four communities are sharp, but floristically they intergrade. The species found in the moor are all common in alpine vegetation throughout the State.

The Pine Lake moor grades into scrub and forest in a mosaic fashion to the east, and more ab-

TABLE 4
THE RELATIVE ABUNDANCE* OF SPECIES IN THE ZONES OF THE PINE LAKE MOOR

Species	Zone (see Figure 5) 1	2	3	4	5
Astelia alpina	c	vc	d	vc	vc
Gleichenia alpina	-	vc	c	r	vc
Carpha alpina	-	c	o	vc	vc
Sprengelia incarnata	-	c	o	vc	vc
Drosera arcturi	-	o	c	o	r
Calorophus minor	-	c	-	vc	vc
Gaimardia setacea	-	o	-	o	o
Microlaena tasmanica	o	o	-	r	c
Richea scoparia	c	-	-	c	d
Eucryphia milliganii	c	-	-	-	r
Richea pandanifolia	o	-	-	-	o
Nothofagus gunnii	d	-	-	-	-
Orites diversifolia	c	-	-	-	-
Phyllocladus aspleniifolius	c	-	-	-	-
Archeria hirtella	o	-	-	-	-
Cenarrhenes nitida	o	-	-	-	-
Richea milliganii	o	-	-	-	-
Gahnia grandis	o	-	-	-	-
Prionotes cerinthoides	r	-	-	-	-
Bauera rubioides	c	d	c	-	-
Lomatia polymorpha	c	r	-	-	-
Leptospermum nitidum	o	o	-	-	-
Diplaspis hydrocotyle	-	o	-	-	-
Diselma archeri	-	o	-	-	-
Epacris serpyllifolia	-	d	r	-	-
Juncus subsecundus	-	o	o	-	-
Cyperaceae sp.	-	o	c	-	-
Senecio pectinatus	-	-	r	-	-
Schizaea fistulosa	-	-	-	r	-
Microcachrys tetragona	-	-	-	d	r
Oreobolus pumilio	-	-	-	c	c
Athrotaxis selaginoides (seedlings)	-	-	-	r	r
Mitrasacme montana	-	-	-	c	o
Pentachondra pumila	-	-	-	c	vc
Actinotus moorei	-	-	-	c	c
Coprosma moorei	-	-	-	o	c
Herbaceous Compositae sp.	-	-	-	c	vc
Actinotus suffocata	-	-	-	r	r
Coprosma nitida (seedlings)	-	-	-	-	r

* d = dominant and abundant o = occasional
vc = very common r = rare
c = common

ruptly in other directions. The openings at the forest edge vary greatly in their character, although the ground surface is generally hummocky, with organic hummocks up to 1.5 m in height and diameter, covered by a *Pentachondra pumila-Calorophus minor* mat heath. Between the hummocks, *Astelia alpina*, the endemic fern *Gleichenia abscida* or *Epacris serpyllifolia* may dominate the ground cover. Shrub-sized *Richea scoparia* and *R. milliganii* are frequent in the openings.

The hummocks may partly derive from variations in the till surface, but seem mainly to have a biological origin. Examination suggested that most are formed when the stumps of dead trees or shrubs act as an anchoring medium for mosses, lichens and higher plants, whose wastes, combined with the decomposition products of the stumps, produce the organic mounds.

(c) The High Altitude Heaths and Herbfields

Vegetation dominated by dwarf, prostrate and bolster shrubs covers most of the two mountains (Fig. 4). However, taller heaths are extensive where shelter from the wind is provided by boulders in the better drained areas, and herbfields are found in snow lie situations on both mountains (Fig. 4).

At least eight distinct species associations are found in the high altitude heaths and herbfields (Table 5). The sequence from associations A to F relates to an edaphic sequence from water-logged, peaty shallow soils to well drained, deep mineral soils. Exposure to wind, period of snow lie and parent rock also influence the species composition of the vegetation. Those species in groups A and B characterize the low closed-heath communities dominated by bolster plants. This association generally occurs in areas of low relief and poor drainage, although it is also represented at site J, a steep snow lie area in the lee of the Boomerang. At the other extreme, the taller closed heath of group H is best developed on the edges of the mountain plateaux where weathering has produced deep rocky soils and drainage is free, although seepage provides a high moisture availability. Group E species characterize sites where drainage is free but there is more of a tendency towards drought than at the group H sites, with group F sites appearing intermediate in their characteristics between those of E and H.

Of the associations shown in Table 5, C, D and E are confined to the Boomerang and H is most widespread on Mt. Bobs. Associations A, B, F and G are found on both mountains. The two mountains are floristically distinct. Of the 115 species found in the high altitude heaths and herbfields of the study area 39 were found only on the Boomerang and 8 were confined to Mt. Bobs (Appendix). The physiognomy and patterning of vegetation on the two mountains is also markedly different. The peculiar properties of the contrasting parent materials of the two mountains are partly responsible for these differences, through the different substrate characteristics that develop from them.

THE BOOMERANG

The topographic relationships of most of the communities found on the Boomerang are shown in Fig. 7, and the distribution of broad structural units is shown in Fig. 4.

1. Fjaeldmark (Low Open-Heath to Low Open-Shrubland)

The fjaeldmark vegetation occurs along the mudstone crest of the Boomerang. It forms stripes which are orientated along the contours on the gentle slopes and associated with the pattern of non-sorted steps described below. On steeper westerly slopes some vegetation stripes are orientated at right angles to the contours. These appear to derive from wind action, typically occurring to the leeward of low outcrops of rock, with the vegetation extending in a tail that tapers off from behind the peak of the rock.

The composition (I and K, Table 5) and dominance of the fjaeldmark vegetation is highly variable. At the summit, where bare rocky ground occupies most of the surface, the species are *Poa gunnii*, forming wind-abraded rings, *Podocarpus lawrencii* and *Richea sprengeloides*, prostrate as if steam-rollered, and the herbaceous species *Dichosciadium ranunculaceum* and *Rubus gunnianus*.

The non-sorted steps of the Boomerang have considerable lateral extent (Pl. 9), some following the contours around the crest for several hundred metres. They are found on all aspects but are most extensively developed on the wide, gentle (5-10°) slopes with northeast and southeast aspects down the 'arms' of the Boomerang. The treads of the steps have a downhill slope of 0-5°, and usually carry no vegetation at all, having a surface cover of mudstone fragments over a mixture of stone fragments and fine silt. Their width varies between 0.5 and 6 m. The risers are fully vegetated, and vary in width between 0.5 and 2 m. They slope downhill at 20-30°, so the treads of the steps are separated elevationally by about 0.2-0.8 m.

On gentle slopes in less exposed situations, including some of the risers of the non-sorted steps, complex matrices of bolster plants form a smoothly undulating cover. Species found in the bolsters include *Abrotanella forsterioides*, *Dracophyllum minimum*, *Pterygopappus lawrencii*, *Donatia novae-zelandiae*, *Mitrasacme archeri* and *Oreobolus pumilio*. *Podocarpus lawrencii* dominates most of the risers. On the

PLATE 9
Non-sorted steps on mudstone, at 1040 m on the Boomerang.

more sheltered steeper slopes, the fjaeldmark is replaced by heaths up to 1 m tall, dominated by shrubs such as *Richea scoparia* and *Eucalyptus vernicosa*.

The migration of fjaeldmark plants to leeward, as the windward edge of their canopy is eroded, has been described for Mt. Twynam, in the Australian Alps, by Barrow *et al.* (1968). This process is also occurring on the Boomerang, both for *Poa gunnii* at the summit, and bolster complexes on exposed slopes at slightly lower altitude (Pl. 10).

2. *Milligania densiflora-Astelia alpina* OPEN-HERBLAND

This community occurs to the leeward of the fjaeldmark, on 25-35° slopes near the central bend of the Boomerang (Fig. 7). Its distribution clearly relates to that of late-lying snow. In November 1977 about 1 m of snow covered the community, while snow cover was only patchy elsewhere, and small patches of snow remained in December. The community is widest on the south-facing, less insolated slope.

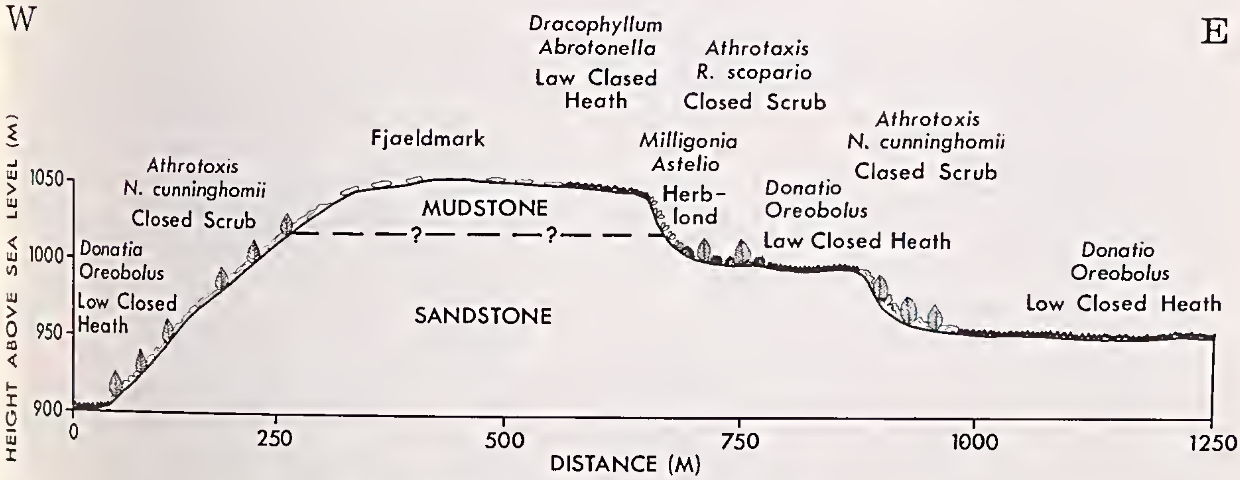

Fig. 7 — Transect across crest of the Boomerang.

PLATE 10
Bolster complexes eroded to windward and spreading to leeward, at 1060 m on the north west side of the Boomerang.

Only about 60% of the surface is vegetated, and there is evidence of considerable downslope movement of the loose mantle of mudstone weathering products that makes up the substrate. *M. densiflora* and *A. alpina* account for about two thirds of the vegetation cover, with a variable mixture of grasses, sedges, forbs and small shrubs making up the remainder (site J, Table 5). The rare endemic *Geum talbotianum* is concentrated in the upper part of this community, to which it is confined in the study area.

3. *Donatia novae-zelandiae-Oreobolus pumilio* LOW CLOSED-HEATH

This community occurs on smooth gentle slopes on the sandstone of the Boomerang (Fig. 4; Table 5, sites L and M). The community varies from 4 to 15 cm in height and is dominated by the bolster shrub *D. novae-zelandiae*, the bolster sedge *O. pumilio* and the small leaved shrub *Epacris serpyllifolia*. On the gentlest slopes *Isophysis tasmanica* and *Restio complanatus* and the creeping pine *Microcachrys tetragona* share dominance, as does *Carpha alpina* on slightly steeper slopes. A variety of rosette herbs and prostrate shrubs occur on and between the bolster plants which are usually partly overgrown.

4. *Richea scoparia-Nothofagus cunninghamii* HEATH

This community occupies the well-drained parts of the Boomerang not subject to long periods of snow lie (e.g. Fig. 7). The heaths vary in height from 0.1 to 2 m tall and vary in the cover of the tallest stratum from 30 to 100%. Although *Richea scoparia* and *N. cunninghamii* are almost invariably among the dominants, a highly variable mixture of other species share the tallest stratum. *Nothofagus gunnii* dominates small areas on south and east-facing slopes below the snow patch community and *Athrotaxis selaginoides* is a widespread co-dominant on all but the driest sites and those that have been recently burnt. *Eucalyptus vernicosa* and *Eucryphia milliganii* are also frequent co-dominants. *Epacris serpyllifolia, Bauera rubioides, Cyathodes parvifolia, Coprosma nitida, Orites revoluta* and *Celmisia longifolia* are other frequent and widespread members of this community.

MT. BOBS

The vegetation mapping units shown for Mt. Bobs (Fig. 4) mask some marked local variation. For instance, the eastern slopes are vegetated by a mosaic of heaths of varying height, cover and dominance. However, the major variation in the vegetation of Mt. Bobs is between the plateau surface, most of which is covered by a smoothly undulating carpet of bolster plants, and the surrounding slopes on which the predominant cover types are taller heaths and bare rock.

1. *Donatia novae-zelandiae-Oreobolus pumilio* LOW-HEATH

This is the widespread community of the plateau. Its species composition differs somewhat from the same community on the Boomerang (Table 5, compare N, O and P to L and M). Three variants of this community are evident on Mt. Bobs. On raised mounds (Pl. 11) *Carpha alpina* dominates the in-

PLATE 11
Donatia novae-zelandiae-Oreobolus pumilio low-heath on Mt. Bobs plateau. *Carpha alpina* (light coloured, curly-leafed sedge), *Dracophyllum milliganii*, *D. novae-zelandiae* and *O. pumilio* are the dominants.

terstices between hummocky bolsters mostly consisting of *Donatia novae-zelandiae* and *Dracophyllum minimum* (e.g. O, Table 5). In lower lying areas the bolster plants form a virtually continuous undulating cover. The species forming the bolsters are *Donatia, Dracophyllum minimum, Abrotanella forsterioides, Pterygopappus lawrencii, Ewartia meredithеae, Mitrasacme archeri* and *Oreobolus pumilio*. A variety of small and dwarfed shrubs, rosette plants and sedges (e.g. N, Table 5) grows in the cushions. The 20-30 cm deep peat layer is absent from the lowest lying, flat, rocky areas, in which water covers the ground for much of the year (Pl. 12, dark areas in mapping unit 1, Fig. 4). These areas have a sparse (usually less than 10%) cover consisting mainly of cushion and rosette plants (P, Table 5). Most of their surface is covered by flat, plate-like dolerite fragments, aligned horizontally over shallow, rocky soil. These open depressions appear to be diminishing in area, with marginal invasion by bolsters (Pl. 12). No actively enlarging depressions were found, and only a very few areas of breakup of the bolster mat, in the most elevated parts of the community, were evident. The combination of shallow, rocky soil, protracted snow lie, submergence for much of the growing season and severe frost heaving in the open depressions must make re-vegetation extremely difficult. The origin of these open depressions is unknown, but may well derive from the destruction of bolster moor in slight local depressions during exceptionally severe winters, and subsequent oxidation and ablation of the peat layer. Local relief within this community is insufficient to allow the cyclical process of stream damming by bolsters, heath development after water diversion and eventual reflooding and reversion to bog, proposed for similar communities on the Central Plateau by Jackson (1973). Although fire may have bared the plateau surface in the distant past, it is most unlikely that it would have burnt in the complex pattern evident from Fig. 4, and no evidence of fire was found, so it is considered improbable that fire is a causative factor in the patterning described above.

2. *Richea pandanifolia-R. scoparia* LOW SHRUBLAND

This community occurs on steeper slopes on the plateau surface, where there is some degree of flushing, with a consequent increase in aeration relative to that in the previous community, and a slight decrease in exposure to the wind. The sparse upper stratum is dominated by the two *Richea* species, which are equal in terms of cover, although *R. pandanifolia*, occurring in its dwarfed alpine form, is more abundant (Pl. 13). About 70% of the lower stratum is occupied by the silvery leaves of *Astelia alpina*, with bolster plants over most of the remainder. The floristic composition of one part of this community, in which the bolster plants were absent, is shown (D, Table 5). The community has not been distinguished from *Donatia novae-zelandiae-Oreobolus pumilio* low heath in Fig. 4.

TABLE 5
ALPINE COMMUNITIES

		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
A	*Mitrasacme archeri*	-	-	-	-	-	-	-	-	-	x	x	x	x	x	-	-
	Abrotanella forsterioides	-	-	-	-	-	-	-	-	-	x	x	x	-	x	-	x
	Microcachrys tetragona	-	x	-	-	-	-	-	-	-	x	x	x	x	-	-	-
	Helichrysum milliganii	-	-	-	-	-	-	-	-	-	x	x	-	-	x	-	x
	Dracophyllum minimum	-	-	-	-	-	-	-	-	-	x	x	-	-	x	x	-
	Ewartia meredithea	-	x	-	-	-	-	-	-	-	x	-	-	x	x	-	x
	Actinotus suffocata	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x
B	*Astelia alpina*	x	-	x	x	x	x	x	-	x	x	x	x	-	-	x	x
	Carpha alpina	-	x	-	-	-	x	-	x	x	x	x	x	x	x	x	x
	Sprengelia incarnata	x	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x
	Oreobolus pumilio	x	-	-	-	-	-	x	x	-	x	x	x	x	x	x	x
	Donatia novae-zelandiae	-	-	-	-	-	-	-	x	x	-	x	x	x	x	x	x
	Erigeron stellatus	-	-	-	-	-	-	x	x	x	x	-	x	x	x	x	x
C	*Milligania densiflora*	x	-	x	-	-	-	-	x	x	x	x	--	-	-	-	x
	Haloragis montana	-	x	-	-	x	-	-	x	x	x	-	-	-	-	-	-
	Richea sprengeloides	-	x	x	-	-	-	-	x	x	-	x	-	-	-	-	-
	Euphrasia striata	-	x	-	-	-	-	x	x	-	x	-	-	-	-	-	x
	Podocarpus lawrencii	-	x	x	-	-	-	-	-	x	x	x	-	-	-	-	-
	Schoenus sp.	-	-	-	-	-	-	-	x	x	x	-	-	-	x	-	-
D	*Poa gunnii*	-	-	-	-	-	-	x	x	-	x	x	-	-	-	-	-
	Diplaspis cordifolia	-	x	-	x	-	-	x	x	x	x	x	x	-	x	-	-
	Pentachondra pumila	-	x	-	-	x	-	x	x	x	x	x	-	x	x	-	-
	Oreobolus acutifolius	-	-	-	x	x	-	x	x	x	x	-	-	-	x	-	-
E	*Epacris serpyllifolia*	x	x	-	-	x	x	x	x	x	-	x	x	x	-	-	-
	Nothofagus cunninghamii	x	x	-	-	x	x	x	x	x	-	-	-	-	-	-	-
	Bauera rubioides	x	-	-	-	x	x	x	x	-	-	-	x	-	-	-	-
	Cyathodes parvifolia	-	x	-	-	x	x	x	x	-	-	-	-	-	-	-	-
	Eucalyptus vernicosa	-	-	-	-	x	x	x	x	x	-	-	-	-	-	-	-
	Celmisia longifolia	-	-	-	-	x	-	x	x	x	-	-	-	-	-	-	-
	Archeria serpyllifolia	-	x	-	-	x	-	x	-	x	-	-	-	-	-	-	-
	Coprosma nitida	-	x	-	-	x	x	x	-	-	-	-	-	-	-	-	-
	Trochocarpa cunninghamii	-	x	-	-	-	x	x	-	x	-	-	-	-	-	-	-
	Diplarrena latifolia	x	-	-	-	x	-	x	-	x	-	-	-	-	-	-	-
	Eucryphia milliganii	x	-	-	-	-	x	x	x	-	-	-	-	-	-	-	-
	Gahnia grandis	x	-	-	-	x	x	-	-	x	-	-	-	-	-	-	-
F	*Orites revoluta*	-	x	x	x	x	x	-	x	x	x	x	-	-	-	-	-
	Richea scoparia	-	x	x	x	x	x	x	x	x	-	-	-	-	-	-	-
G	*Drimys lanceolata*	-	x	x	x	x	-	x	x	x	-	-	-	-	-	-	-
	Calorophus minor	x	-	-	x	x	-	-	x	-	-	-	x	x	-	x	-
H	*Isophysis tasmanica*	x	-	-	x	-	-	-	x	x	-	-	x	x	-	-	-
	Bellendena montana	x	x	x	x	x	-	-	x	x	x	x	-	-	-	-	-
	Athrotaxis selaginoides	x	x	-	x	x	x	-	-	-	-	x	-	-	-	-	-
	Diselma archeri	x	x	x	-	x	-	-	-	-	-	x	-	-	-	-	-
	Orites diversifolia	x	-	x	-	x	-	-	x	x	-	-	-	-	-	-	-
	Helichrysum backhousei	-	x	-	x	x	-	x	-	x	-	-	-	-	-	-	-
	Orites acicularis	-	x	x	x	-	-	-	-	-	-	x	-	-	-	-	-
	Drosera arcturi	x	-	-	-	-	-	x	-	x	-	x	x	-	x	-	-
	Microlaena tasmanica	-	x	-	x	x	-	-	x	-	x	-	x	-	-	-	-
	Senecio pectinatus	-	x	-	-	-	-	-	-	-	x	x	-	-	x	-	x
	Richea pandanifolia	-	-	x	x	-	x	x	-	x	-	-	-	-	-	-	-
	Uncinia compacta	-	-	x	x	x	-	-	-	-	x	x	-	-	-	-	-
	Dracophyllum milliganii	x	-	-	-	-	-	-	-	-	-	-	x	x	-	x	-
	Number of species	29	32	15	16	35	18	36	30	33	33	35	21	22	22	12	12

PLATE 12
Donatia novae-zelandiae-Oreobolus pumilio low-heath on Mt. Bobs plateau, showing low-lying, partly inundated depression.

3. *Milligania densiflora-Astelia alpina* OPEN-HERBLAND

As on the Boomerang, this community occupies areas on the upper eastern slopes where the topography allows snow to accumulate and protects it from wind ablation. The physiognomy and floristics of the community on the two mountains are similar.

4. *Diselma archeri-Bellendena montana* HEATH

This community, like the *Richea scoparia-Nothofagus cunninghamii* heath of the Boomerang which it most closely resembles, is highly heterogeneous. The species that have been used to name the community are constant (A, B and C; Table 5), but *Bellendena montana* is never a dominant, and *Diselma archeri* shares the dominant stratum with many other species and is usually their subordinate. On the steep, rocky, upper western slopes of Mt. Bobs *Nothofagus cunninghamii* and *Richea scoparia* dominate a closed-heath. On the steep eastern slopes the dominants include *Nothofagus gunnii, Athrotaxis selaginoides, N. cunninghamii* and *R. scoparia*. On the most steep and broken areas on top of the plateau *E. vernicosa* is sometimes dominant in mixture with the latter three species and *Diselma*. Two of the mapping units (Fig. 4) include this community, the differentiation being based on the amount of bare rock visible on the aerial photographs.

TABLE 5 *(continued)*

Additional species: *Abrotanella scapigera* DE, *Acaena montana* JK, *Actinotus moorei* M, *Agastachys odorata* A, *Blandfordia punicea* A, *Blechnum wattsii* I, *Carex* sp. B, *Celmisia saxifraga* K, *Coprosma moorei* J, *Cyathodes dealbata* BK, *Danthonia* spp. JN, *Dichosciadium ranunculaceum* JK, *Euphrasia hookeri* KLN, *Exocarpos humifusus* FGI, *Forstera bellidifolia* FLM, *Gaimardia setacea* O, *Gaultheria hispida* G, *Gentianella diemensis* GJ, *Geum talbotianum* J, *Gleichenia alpina* ALM, *Grammitis armstrongii* J, *Helichrysum pumilum* AM, *Leptospermum nitidum* A, *Lomatia polymorpha* A, *Lycopodium fastigiatum* AM, *L. scariosum* FK, *L. selago* G, *Mitrasacme montana* E, *Monotoca submutica* EG, *Nothofagus gunnii* A, *Olearia ledifolia* BC, *O. pinifolia* BEG, *Ourisia integrifolia* EHI, *Oxalis lactea* J, *Persoonia gunnii* AEG, *Pimelea sericea* AB, *Poranthera microphylla* K, *Prionotes cerinthoides* EG, *Pterygopappus lawrencii* KN, *Restio complanatus* LM, *Richea curtiseae* NO, *Rubus gunnianus* EGK, *Senecio leptocarpus* EG, *S. papillosus* BCK, *Stylidium graminifolium* AM, *Telopea truncata* A, *Tetracarpaea tasmanica* EG, *Trochocarpa gunnii* G, *Xyris marginata* M.

DISCUSSION

The complete absence of *Eucalyptus* from the forest in the three sub-alpine valleys to the east, southwest and northwest of the Boomerang appears to have resulted from a combination of low fire frequency, barriers to successful regeneration in the periods between fires, and the lack of nearby seed sources of *Eucalyptus* populations able to compete in the subalpine forest.

Over most of the area of these valleys drainage is free, and stands of *Eucalyptus* species can be found elsewhere in southwest Tasmania on all of the rock types that occur in the valleys. Thus, edaphic factors are not responsible for eliminating *Eucalyptus*.

The shrub-sized *E. vernicosa* is able to regenerate above the tree-line without fire, particularly on the mudstone, where considerable areas of exposed mineral soil form a suitable seed bed. Although harsh climatic conditions must greatly lower the chances of successful regeneration, some young individuals had obviously established without fire. Below about 1000 m, the denser, taller vegetation produces a thick organic covering over the ground surface, and lowers the light intensity at ground level, so that *Eucalyptus* regeneration is virtually impossible without fire (Gilbert 1959, Mount 1969). Although some *E. vernicosa* seed from the alpine populations probably reaches the subalpine sites when fire has prepared a seed bed it appears that if any seedlings do establish, they die after being over-topped by the faster growing, taller rainforest species, since no *E. vernicosa* was found on the Boomerang at sites that had been burnt within the last century. One adult *E. vernicosa*, judged to be at least 200 years old, was found at an altitude of 850 m (near site A, Fig. 5), on the edge of a cliff where it had been able to avoid competition from the surrounding rainforest. Although reaching a height of 4 m, it had the small (2 cm) leaves characteristic of the alpine populations. At more fire-prone sites such as Mt. Arrowsmith, *E. vernicosa* extends downslope in taller shrub and tree-sized cline forms, with much larger leaves (Jackson 1960). It seems that average fire frequency in the Mt. Bobs area has been too low to allow the survival of such populations.

Leptospermum nitidum, which has a similar life cycle to the eucalypts, occurs in the Pine Lake-Lake Sydney subalpine valley. Most of the individuals are found on poorly drained sites, and are adults nearing the end of their life, but some regeneration has occurred on sites burnt within the last century. Occasional seedlings were found in open areas around the edge of the Pine Lake Moor, showing that the species could regenerate in open swampy areas in the absence of fire. It appears that such open, swampy areas, around Lake Sydney and the Pine Lake Moor, provide sites for regeneration during the long periods without fire in which the species would otherwise die out like the eucalypts.

The minimum ages on the *Athrotaxis* in the tall open forest south of Pine Lake, together with the absence of any fire scarring in this forest, show that some of the valley has been unburnt for at least 500 years. However, fires have burnt a small area just to the north of Lake Sydney, and much of the Boomerang (see Fig. 4). The dates of these fires, judging from ring counts on *Athrotaxis* saplings, were about 1890 and 1930 (most probably 1934, a year of widespread fires in South-West Tasmania) respectively. Some other stands of scrub and forest around the two mountains have been burnt 200-300 years ago, judging from the presence of numerous dead trunks of fire-killed *Athrotaxis*, and the size of the regrowth.

After a fire, the following sequence is typical on well drained slopes. *Nothofagus cunninghamii* regenerates from coppice, and the other species regenerate from seed dispersed from unburnt areas. *N. cunninghamii*, *Eucryphia lucida*, *Bauera rubioides* and *Richea scoparia* dominate the regrowth for the first few decades. *A. selaginoides* establishes at densities that decrease from the edges of the burn. Over small (less than 1 km) burns the density is typically equivalent to very open woodland. Although this species appears to establish only after other species can act as a nurse crop, it has a faster growth rate once established, and after 2-3 centuries a structure of emergent *A. selaginoides* woodland over a closed scrubland or low forest of the other species develops. Some species present in the early stages of succession, such as *Bauera* and *Gahnia grandis*, are overtopped and eliminated. This stage is typical of most of the western slopes of the Boomerang (Plate 14).

In the tall open-forest south of Pine Lake, there is some evidence of a two-generation age structure for *Athrotaxis*, with occasional very large (greater than 1.5 m d.b.h.) individuals and a much higher density of narrow crowned individuals with d.b.h. of 0.4-1.2 m. This forest is undergoing a process of self-thinning, with 10-20% of the narrow-crowned *Athrotaxis*, and a similar proportion of the *Nothofagus* and *Atherosperma*, dead or dying. The basal area of the stand (219 m^2/ha) is very high in comparison with the values obtained by Ogden and Powell (1979) for forests on the lower mountain slopes at Mt. Field. These workers obtained mean and maximum basal areas of 121.9 and 208.5 m^2/ha for tall open eucalypt forest and mixed (eucalypt-rainforest) forest at altitudes up to 748 m, the corresponding figures for subalpine forests above this altitude being 38.6 and 76.3 m^2/ha. Examination of the increment cores from the Pine Lake forest shows that the growth rates of most of the *Athrotaxis* has slowed

PLATE 13
Richea pandanifolia —*R. scoparia* low-shrubland, with *Astelia alpina* understorey, on sloping area, Mt. Bobs Plateau.

PLATE 14
Lake Sydney (foreground), Pine Lake and north west slope of the Boomerang, seen from Mt. Bobs. Fire boundaries are clearly visible.

dramatically over the last century, presumably because of the development of intense competition. On most trees there has been a diameter increment of less than 2 cm over the last 50 years, compared with a rate of 10-20 cm per century for most of their lives.

The structure of the Pine Lake forest suggests that there was a phase of heavy *Athrotaxis* recruitment between 500 and 400 years ago. At that time, there were already a few adults (perhaps established as a result of a past fire, and emergent at open woodland density over a rainforest canopy) and these trees probably were the seed source for the major recruitment phase. No seedlings or saplings of *Athrotaxis* were found, nor was there evidence of recruitment over the last 3 centuries. Ogden (1978) has found stands of *Athrotaxis* consisting of two or three generations, separated by quite wide gaps, at other Tasmanian sites. The factors responsible for controlling this phasic pattern of regeneration in *Athrotaxis* are not known. The absence of fire scars on the largest, oldest trees suggests that fire was not the factor enabling the self-thinning *Athrotaxis* age class to establish at Pine Lake. Fluctuations in seed supply are not responsible, as the species has at least one good seed year per decade, and produces seed in nearly all years (W. D. Jackson, pers. comm. 1978). It appears that low light intensity can also be rejected as the factor preventing present-day recruitment of *Athrotaxis,* since regeneration of *Nothofagus, Atherosperma* and *Phyllocladus* is occurring, and *Athrotaxis* seedlings and saplings have been observed by Harwood in the Cradle Mountain area, in forests that are just as dense as the Pine Lake forest.

The non-sorted steps of the Boomerang closely resemble the terraces on the eastern leeward slopes of Macquarie Island, described by Taylor (1955) except for the completely different floristic composition of their fjaeldmark vegetation. In both cases the treads are bare and the risers are fully vegetated, although at the latter site the vertical distance between the treads is greater (0.6 to 6 m). This difference can be ascribed to the greater overall slope of the terrain on which the steps are developed at Macquarie Island, since Taylor noted that the vertical distance between treads tended to increase with steepening of the topography. Steps of the type noted by Taylor on the western windward slopes, on which the treads are vegetated and the risers are bare, do not occur on the Boomerang. Costin *et al.* (1967) studied non-sorted steps near Mt. Kosciusko in the Australian Alps. These differ from the steps at the Boomerang in a number of ways. They have a much smaller lateral extent, and are not regularly arranged on the slope. Individual steps are often lobed, in contrast to the uniform terraces following the contour lines at the Boomerang. In general, the Mt. Twynam steps are more fully vegetated, carrying fjaeldmark or developing herbfield on the treads as well as the risers.

Taylor suggested that the main factor responsible for the development of steps in fjaeldmark vegetation was strong wind, which so restricted plant growth that a continuous vegetation cover could not develop. He noted that on both the leeward and windward slopes of Maquarie Island, the vegetation was growing on that part of the step that was sheltered from the direct blast of the wind. Taylor suggested that the steps on lee slopes originate when soil creep builds up material on the uphill side of the few plants initially colonizing the bare slope, giving them more protection from the wind and enabling them to grow and accumulate more material. The small steps thus developed would eventually coalesce laterally to form extensive terraces, any height differences between laterally adjacent steps being eliminated by turbulence that would increase wind strength at the higher level, killing plants there, with subsequent redistribution of soil materials by soil creep. Taylor judged the terraces to be stable in position and shape, once formed. Costin *et al.* however, considered that the steps in the Mt. Kosciusko area were formed initially by mass downslope movement, most probably initiated by impeded drainage brought about by deep freezing followed by differential thawing, in previous colder climates. The Mt. Kosciusko steps, like those on the lee slopes of Macquarie Island, appear to be stable at present, apart from downward surface movement from the treads brought about primarily by the numerous freeze-thaw cycles.

The assessment of the relative importance of these two suggested modes of step origin at the Boomerang must await more detailed observations, including excavations. There appears to be no mass downslope movement at present, the risers being flat or concave in cross section, and there being no obvious downward distortion of root systems (cf. Costin *et al.* 1967). The mixture of small rock fragments and fine silt that results from the weathering of the mudstone is very unsuitable for plant growth, probably because of the low water holding capacity and lack of protection against frost heaving. Soils developed from dolerite, with similar exposure at the same altitude (for example, the western edge of the Mt. Bobs plateau) are usually fully vegetated, and non-sorted steps do not form. Active periglacial features are almost entirely confined to the mudstone in the study area, the exception being a few apparently active stone polygons in bare depressions on the Mt. Bobs plateau.

However, non-sorted steps, albeit less clearly developed, have been observed on a dolerite substrate on the western face of Mt. Rufus, at an altitude 300 m higher than that of the Boomerang.

Although quantitative soil analyses have not been undertaken, it is clear from general observations that the characteristics of the various substrates in the area affect the species composition and structure of the vegetation in a number of ways. The most striking example is the refuge provided for forbs, ferns and grasses by the limestone cliffs south of Lake Sydney. Over most of the lower valley slopes the parent material is a mixture of more than one rock type, because of periglacial and glacial downslope movement. Near the summits, substrate effects can be more clearly discerned. Permian mudstone has the highest percentage of bare ground, and this appears to favour establishment of *Eucalyptus vernicosa*, which is most common on mudstone. No species was completely confined to the mudstone, however. The flat shelves of sandstone on and around the Boomerang are generally occupied by low closed-heath, whereas on steeper slopes at the same altitude scrub communities occur on all rock types. The horizontal bedding and lack of vertical jointing on the sandstone shelves has led to the development of shallow (usually less than 15 cm) peaty soil over solid bedrock, very prone to waterlogging. *Restio complanatus* is very common on these sandstone shelves, but restricted to them within the study area, and generally appears to be restricted to silica-rich sites (Kirkpatrick, unpublished data). The other 38 species confined to the Boomerang are not believed to be exclusive to sandstone and mudstone substrates in other Tasmanian mountains. However, of the alpine species confined to Mt. Bobs, *Pimelea sericea* and *Lagenophora stipitata* are generally limited in their distribution to base-rich substrates.

Mt. Bobs has fewer species of vascular plants above treeline than the Boomerang (77 compared with 106) despite its having a rather larger alpine area. This may be largely accounted for by its very uniform topography, with the resultant development of one plant community over almost all of the plateau surface.

Of the species observed above the treeline on Mt. Bobs, 58% are Tasmanian endemics, the corresponding figures for the Boomerang and the adjacent forest and closed-scrub communities being 57%. These figures are high when compared with the 33% of Tasmanian endemics out of the 110 species found above treeline at Mt. Wellington (Ratkowsky & Ratkowsky 1976).

The alpine floras of Mt. Bobs and the Boomerang more closely resemble those of Mt. Field (Davies 1978) with which they respectively share 64 and 83 of its 140 species, than Mt. Wellington with which they respectively share 27 and 36 species. Mt. Wellington receives only 1400 mm of precipitation per annum and its alpine vegetation includes a 'dry element' and many native and exotic adventives absent from the other mountains. The Mt. Bobs-Boomerang flora does not include any exotic species. The relatively large number of species found in alpine vegetation at Mt. Field may be a reflection of the larger (12 km^2) area above the treeline (Fig. 1). Mt. Bobs and the Boomerang share similar numbers of species with the West Coast Range (Kirkpatrick 1977), the Eastern Arthur Range (Kirkpatrick, unpublished data) and Mt. Picton (Kirkpatrick, unpublished data) as they do with Mt. Field. These mountains consist largely of highly siliceous rocks, in contrast to the dolerite of Mt. Field and Mt. Wellington, but are within the zone of very high precipitation with annual totals probably exceeding 2000 mm in all cases. These comparisons suggest that climate may play a greater role in the floristic differentiation of Tasmanian alpine vegetation than substrate differences.

The alpine vegetation of Mt. Bobs and the Boomerang exhibits three features previously undescribed from Tasmania. These features are:

1. The non-sorted steps of the Boomerang.

2. The snow patch herbland of the Boomerang.

The *Milligania densiflora-Astelia alpina* association has been observed by Kirkpatrick at Walled Mountain and the Eastern Arthur Ranges at sites where snow would tend to persist, but at neither of these localities is there the striking development evident on the Boomerang.

3. The open depressions on the Mt. Bobs plateau.

The degree of dominance of the bolster plants in the *Donatia novae-zelandiae-Oreobolus pumilio* low closed-heath on Mt. Bobs, and the large area that it covers, make it probably the best example of this community in Tasmania, to which it is restricted. It is found however at other locations, including Mt. Field and the Eastern Arthur Range.

The study area as a whole is unusual for its generally low incidence of fire. This may have been a factor in favouring development of communities dominated by endemic species, and those with New Zealand and South American affinities, at the expense of the Australian element of the Tasmanian mountain flora.

The maintenance of the present vegetation depends on avoiding an increase in the frequency of fire. Small areas burnt by spot fires, such as that near the sinkhole, regain their pre-burn floristic composition relatively quickly. The recovery of *Athrotaxis* and other fire-susceptible species after larger burns such as that on the northern arm of the Boomerang is a process of centuries of marginal invasion from the edges of the burn, and, once these reach reproductive age, spread from occasional individuals established from propagules dispersing more than the usual few metres. The danger of 'ecological drift' (Jackson 1968) towards a more inflammable vegetation, thus increasing the likelihood of further fires, may be considered after an extensive fire. For cxample, the fire risk at site 5, burnt about 50 years ago (Fig. 5) appears greater than that at the adjacent site 4 (unburnt for centuries) because of the lower, more broken canopy allowing greater drying of fuels in hot weather, and the presence of greater amounts of inflammable understorey fuels such as those provided by the sedge *Gahnia grandis*.

A fire that burnt most or all of the area, as has occurred in historical times for other Tasmanian mountains, might effect extremely long term changes in the composition of its vegetation. In particular, the gymnosperm species and *Nothofagus gunnii* would be eliminated until long-distance dispersal returned them to the area. Thus, the risk of increased fire frequency referred to in the introduction has serious implications.

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APPENDIX

SPECIES OBSERVED IN THE MOUNT BOBS-BOOMERANG-LAKE SYDNEY-PINE LAKE AREA DECEMBER 1976 (T. MOSCAL) AND DECEMBER 1977 (J. KIRKPATRICK & C. HARWOOD)

	Family	Life form	Locality*				
			BB	BO	M	F	LC
Abrotanella forsterioides Cass.	Compositae	shrub	x	x			
Abrotanella scapigera F. Muell.	"	shrub	x	x			
Acaena montana Kirk.	Rosaceae	herb		x			
Acaena novae-zelandiae Hook. f.	"	herb					x
Actinotus suffocata (Hook. f.) Rodw.	Umbelliferae	herb	x	x	x		
Actinotus moorei Rodw.	"	herb	x		x		
Agastachys odorata R. Br.	Proteaceae	shrub	x	x		x	
Agrostis billardieri var. *filifolia* J.W. Vickery	Gramineae	herb					x
Anodopetalum biglandulosum A. Cunn. ex. Hook. f.	Cunoniaceae	shrub				x	
Anopterus glandulosus Labill.	Escalloniaceae	shrub				x	
+ *Apteroptheris malingii* (Hook.) Cop.	Hymenophyllaceae	fern				x	
Archeria eriocarpa Hook. f.	Epacridaceae	shrub				x	x
Archeria hirtella (Hook. f.) Hook. f.	"	shrub				x	
Archeria serpyllifolia Hook. f.	"	shrub	x	x		x	
+ *Aristotelia peduncularis* (Labill.) Hook. f.	Elaeocarpaceae	shrub		x		x	
Asplenium bulbiferum Forst. f.	Aspleniaceae	fern					x
Asplenium flabellifolium Cav.	"	fern					x
Astelia alpina R. Br.	Liliaceae	herb	x	x	x	x	
Atherosperma moschatum Labill.	Monimiaceae	tree				x	
Athrotaxis selaginoides D. Don.	Taxoidiaceae	tree, shrub	x	x	x	x	

APPENDIX (*continued*)

			BB	BO	M	F	LC
Australina pusilla Gaud.	Urticaceae	herb					x
Bauera rubioides Andr.	Cunoniaceae	shrub	x	x	x	x	
Bellendena montana R. Br.	Proteaceae	shrub	x	x			x
Blandfordia punicea Sweet.	Liliaceae	herb	x	x			
Blechnum chambersii Tindale	Blechnaceae	fern					x
Blechnum fluviatile (R. Br.) E.J. Lowe ex. Salomon	"	fern					x
Blechnum minus (R. Br.) Ettingsh.	"	fern		x			
Blechnum penna-marina (Poir) Kuhn	"	fern					x
Blechnum vulcanicum (Blume) Kuhn	"	fern				x	
Blechnum wattsii Tindale	"	fern		x		x	
Calorophus elongatus Lab.	Restionaceae	herb			x	x	
Calorophus lateriflorus (R. Br.) F. Muell.	"	herb	x	x	x	x	
Cardamine sp.	Cruciferae	herb					x
Carex breviculmis R. Br.	Cyperaceae	herb					x
Carex gaudichaudiana Kunth.	"	herb	x				
Carpha alpina R. Br.	"	herb	x	x	x		
Celmisia longifolia Cass.	Compositae	herb		x			
Celmisia saxifraga Comber	"	herb		x			
Cenarrhenes nitida Labill.	Proteaceae	shrub	x	x		x	
Centrolepis monogyna Benth.	Centrolepidaceae	herb				x	
+ *Chiloglottis cornuta* Hook. f.	Orchidaceae	herb					
+ *Chiloglottis gunnii* Lindl.	"	herb					
Coprosma moorei Rodw.	Rubiaceae	shrub		x	x		
Coprosma nitida Hook. f.	"	shrub	x	x			
Cyathodes dealbata R. Br.	Epacridaceae	shrub	x	x			
Cyathodes juniperina (Forst.) Druce	"	shrub				x	

APPENDIX (*continued*)

			BB	BO	M	F	LC
Cyathodes parvifolia R. Br.	Epacridaceae	shrub	x	x		x	
Danthonia sp.	Gramineae	herb	x	x			
Danthonia purpurescens J.W. Vickery	"	herb					x
Dichosciadium ranunculaceum (F. Muell.) Domin.	Umbelliferae	herb		x			
Diplarrena latifolia Benth.	Iridaceae	herb	x	x		x	
Diselma archeri Hook. f.	Cupressaceae	shrub	x	x			
Diplaspis cordifolia Hook. f.	Umbelliferae	herb	x	x			
Donatia novae-zelandiae J.R. & G. Forst.	Donatiaceae	shrub	x	x			
Dracophyllum milliganii Hook. f.	Epacridaceae	shrub	x	x		x	
Dracophyllum minimum F. Muell.	"	shrub	x	x			
Drimys lanceolata (Poir.) Baill.	Winteraceae	shrub	x	x		x	
Drosera arcturi Hook.	Droseraceae	herb	x	x	x		
Epacris serpyllifolia R. Br.	Epacridaceae	shrub	x	x	x	x	
Epilobium sp.	Onagraceae	herb					x
Erigeron stellatus (Hook. f.) W.M. Curtis	Compositae	herb	x	x			
Eucalyptus vernicosa Hook. f.	Myrtaceae	shrub	x	x			
Eucryphia lucida (Labill.) Baill.	Eucryphiaceae	tree				x	
Eucryphia milliganii Hook. f.	"	shrub	x	x		x	
Euphrasia hookeri Wettst.	Scrophulariaceae	herb	x	x			
Euphrasia striata R. Br.	"	herb	x				
Ewartia meredtheae (F. Muell.) Beauv.	Compositae	herb	x	x			
Ewartia planchonii (Hook. f.) Beauv.	"	herb		x			
Exocarpos humifusus R. Br.	Santalaceae	shrub		x	x		
Forstera bellidifolia Hook. f.	Stylidiaceae	herb		x			
Gahnia grandis Hook. f.	Cyperaceae	herb	x	x	x		
Gaimardia setacea Hook. f.			x	x	x		

APPENDIX (*continued*)

			BB	BO	M	F	LC
Galium sp.	Rubiaceae	herb					x
Gaultheria hispida R. Br.	Ericaceae	shrub		x			
Gentianella diemensis J.H. Willis	Gentianiaceae	herb		x			
Geranium potentilloides L'Herit. ex DC.	Geraniaceae	herb					x
Geum talbotianum W.M. Curtis	Rosaceae	herb		x			
Gleichenia abscida Rodw.	Gleicheniaceae	fern			x	x	
Gleichenia alpina R. Br.	"	fern	x	x	x		
Gnaphalium sp. 1	Compositae	herb					x
Gnaphalium sp. 2	"	herb					x
Grammitis billardieri Willd.	Grammitidaceae	fern				x	
Grammitis armstrongii Tindale	"	fern		x			
Haloragis montana Hook. f.	Haloragaceae	shrub	x	x			
Helichrysum backhousii (Hook. f.) F. Muell. ex Benth.	Compositae	shrub	x	x			
Helichrysum milliganii Hook. f.	"	herb	x	x			
Helichrysum pumilum Hook. f.	"	herb	x	x			
Hierochloe fraseri Hook.	Gramineae	herb				x	
Histiopteris incisa (Thunb.) J. Sm.	Dennstaedtiaceae	fern					x
Hydrocotyle muscosa R. Br.	Umbelliferae	herb					x
Isophysis tasmanica (Hook.) T. Moore		herb	x	x			
Juncus subsecundus N.A. Wakefield	Juncaceae	herb			x		x
Lagenophora stipitata (Labill.) Druce	Compositae	herb	x				
Leptospermum nitidum Hook. f.	Myrtaceae	tree	x	x		x	
Lomatia polymorpha R. Br.	Proteaceae	shrub	x			x	
Lycopodium fastigiatum R. Br.	Lycopodiaceae	herb	x	x		x	
Lycopodium scariosum Forst. f.	"			x			

APPENDIX (*continued*)

			BB	BO	M	F	LC
Lycopodium selago L.	Lycopodiaceae			x			
Microcachrys tetragona (Hook.) Hook. f.	Podocarpaceae	shrub	x	x	x		
Microlaena tasmanica H.	Gramineae	herb	x	x	x		
Microsorium diversifolium (Willd.) Copeland	Polypodaceae	fern					x
+ *Microstrobus niphophilus* Garden & Johnson	Podocarpaceae	shrub			x		
Milligania densiflora Hook.	Liliaceae	herb	x	x			
Mitrasacme archeri Hook. f.	Loganiaceae	shrub	x	x			
Mitrasacme montana Hook. f.	"	shrub	x	x	x		
Monotoca submutica Jarman	Epacridaceae	shrub	x	x		x	
Myriophyllum elatinoides Gaudich.	Haloragaceae	aquatic	in Pine Lake				
Nothofagus cunninghamii (Hook.) Oerst.	Fagaceae	shrub, tree	x	x		x	
Nothofagus gunnii (Hook. f.) Oerst.	"	shrub	x	x	x	x	x
Olearia ledifolia (DC.) Benth.	Compositae	shrub	x	x			
Olearia persoonioides (DC.) Benth.	"	shrub		x		x	
Olearia phlogopappa (Labill.) DC.	"	shrub					x
Olearia pinifolia (Hook. f.) Benth.	"	shrub	x	x			
Oreobolus acutifolius S.T. Blake	Cyperaceae	herb		x		x	
Oreobolus pumilio R. Br.	"	herb	x	x	x		
Orites acicularis R. Br.	Proteaceae	shrub	x	x			
Orites diversifolia R. Br.	"	shrub	x	x		x	x
Orites revoluta R. Br.	"	shrub	x	x			
+ *Oreomyrrhis ciliata* Hook. f.	Umbelliferae	herb		x			
Ourisia integrifolia R. Br.	Scrophulariaceae	herb		x			
Oxalis lactea Hook.	Oxalidaceae	herb		x		x	
Pentachondra pumila (Forst.) R.Br.	Epacridaceae	shrub	x	x	x		
Persoonia gunnii Hook. f.	Proteaceae	shrub		x		x	

APPENDIX *(continued)*

			BB	BO	M	F	LC
Phyllocladus aspleniifolius (Labill.) Hook. f.	Podocarpaceae	shrub, tree		x		x	
Pimelea sericea R. Br.	Thymeliaceae	shrub	x				
Pittosporum bicolor Hook.	Pittosporaceae	shrub					x
Plantago daltonii Dcne.	Plantaginaceae	herb		x			x
Poa gunnii (M.S. J.W. Vickery)	Gramineae	herb		x			
Podocarpus lawrencii Hook. f. in Hook.	Podocarpaceae	shrub	x	x			
Polystichum proliferum (R. Br.) C. Prest.	Aspidaceae	fern					x
Poranthera microphylla Brogn.	Euphorbiaceae	herb		x			
+ *Prasophyllum alpinum* R. Br.	Orchidaceae	herb		x			
+ *Prasophyllum fuscum* R. Br.	"	herb		x			
Prionotes cerinthoides (Labill.) R. Br.	Epacridaceae	shrub		x		x	x
+ *Pterostylis dubia* R. Br.	Orchidaceae	herb				x	
Pterygopappus lawrencei Hook. f.	Compositae	shrub	x	x			
Ranunculus collinus R. Br. ex DC.	Ranunculaceae	herb					x
Restio complanatus R. Br.	Restionaceae	herb		x			
+ *Richea angustifolia* B.L. Burtt.	Epacridaceae	shrub			x		
Richea aff. *curtiseae*	"	shrub	x				
Richea milliganii (Hook. f.) F. Muell.	"	shrub		x		x	
Richea pandanifolia Hook. f.	"	shrub	x	x	x	x	x
Richea scoparia Hook. f.	"	shrub	x	x	x	x	
Richea sprengeloides (R. Br.) F. Muell.	"	shrub	x	x			
Rubus gunnianus Hook.	Rosaceae	herb		x			
Schizaea fistulosa Labill.	Schizaeaceae	fern		x	x		
Schoenus sp.	Cyperaceae	herb	x	x			
Schoenus fluitans Hook. f.	"	aquatic	in Pine Lake				
Scirpus sp.	"	herb				x	

APPENDIX *(continued)*

			BB	BO	M	F	LC
Senecio leptocarpus DC.	Compositae	herb	x				
Senecio papillosus F. Muell.	"	herb	x	x			
Senecio pectinatus DC.	"	herb	x	x			
Sprengelia incarnata Sm.	Epacridaceae	shrub	x	x	x	x	
Stylidium graminifolium Swartz	Stylidiaceae	herb	x	x	x		
Telopea truncata (Labill.) R. Br.	Proteaceae	shrub	x			x	
Tetracarpaea tasmanica Hood. f.	Escalloniaceae	shrub		x		x	
+ *Townsonia viridis* (Hook. f.) Schlecter	Orchidaceae						
Trochocarpa cunninghamii (D.C.) W.M. Curtis	Epacridaceae	shrub	x	x		x	
Trochocarpa gunnii (Hook. f.) Benth.	"	shrub		x		x	x
Uncinia compacta R. Br.	Cyperaceae	herb	x	x		x	
Uncinia tenella R. Br.	"	herb				x	
Veronica calycina R. Br.	Scrophulariaceae	herb		x			
Viola hederacea Labill.	Violaceae	herb					x
Xyris marginata Rendle	Xyridaceae	herb		x			
TOTAL			77	106	30	55	33

* BB = Alpine vegetation, Mt. Bobs; BO = Alpine vegetation, the Boomerang; M = Heath and herbland between Pine Lake and Lake Sydney; F= Forest and scrub; LC= Growing on exposed limestone in the sinkhole or on cliffs along the southern edge of Lake Sydney;+= seen only by T. Moscal.